



Uncovering the San Andreas Fault

Pre-Visit Activities

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What Questions Do Geologists Answer?



Pre-Visit Lesson Plan

Students will prepare each other for their upcoming field trip by developing presentations, activity sheets, and vocabulary lists on geologic topics. Presentation topics are derived from questions geologists can answer through research. These questions cover the range of the earth's structure, plate tectonics, and earthquakes as they relate to the San Andreas Fault. This pre-visit lesson plan forms a foundation and imparts critical knowledge to prepare students for field visit.

Time required: 2 hours and independent research time

Location: classroom

Suggested group size: entire class organized into teams

Subjects: science, physics, mathematics

Concepts covered: natural history, observational techniques,
earth science

Written by: Lynne Dominy and Christie Denzel Anastasia,
National Park Service

Last updated: 04/02/00

Student Outcomes

At the end of this activity, the students will be able to:

- Effectively locate and share information gained through research
- Prepare for upcoming field trip

California Science Standard Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

- 6th grade
- 1a - the fit of the continents, location of earthquakes, etc., provide evidence for plate tectonics
 - 1b - the solid earth has three layers
 - 1d - earthquakes are sudden motions along breaks in the crust called faults
 - 1f - explain major features of California geology in terms of plate tectonics (including mountains, faults, volcanoes)
 - 7b - select and use appropriate tools and technology to perform tests, collect and display data
 - 7d - communicate the steps and results from an investigation





- 7th grade 7a - select and use appropriate tools and technology to perform tests, collect and display data
7b - utilize a variety of print and electronic resources, including the World Wide Web, to collect information
7c - communicate logical connections among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence
7e - communicate the steps and results from an investigation
- 8th grade 9b - evaluate the accuracy and reproducibility of data

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A - Use appropriate tools and techniques to gather, analyze, and interpret data; Develop descriptions, explanations, predictions, and models using evidence; Think critically and logically to make the relationships between evidence and explanations; Communicate scientific procedures and explanations.
- Content Standard B - Motions and forces; Transfer of energy.
- Content Standard D - Structure of the earth system; Earth's history.
- Content Standard F - Personal health; Natural hazards; Risks and benefits.
- Content Standard G - History of Science.

Materials

To be provided by the teacher:

- Research materials such as field guides, relevant books, access to Internet.
- Possible free materials from "Resources" list at end of guide
- Art supplies for students to prepare presentations

To be photocopied from this guide:

- **Responsibilities for Team Presentations** Activity Sheet; one per team
- **Focus Questions** Activity Sheet; one topic per team

Vocabulary

Students will provide vocabulary lists with their presentations.

Procedures

1. Explain assignment to students

Student teams will research topics relevant to their upcoming field trip to Point Reyes National Seashore. They will be responsible for preparing each other through a series of presentations. This will be run as a "scientific symposium" where brief presentations are given and time is allowed for clarifying questions.



2. Create seven student teams

Designate teams and assign topics, or allow students to group themselves according to interest.

3. Provide photocopies to teams

Each team should receive at least one copy of the **Responsibilities for Team Presentations** and **Focus Questions** Activity Sheets.

4. Explain team responsibilities

Reviews **Responsibilities for Team Presentations** and allow for questions. Designate amount of time for research and presentations. Let students know when you expect to receive their activity sheets and vocabulary lists (so you can make photocopies), and what day the presentations will occur.

5. Allow time for independent team study and preparation

Decide whether there is time for students to conduct research during class time or as homework assignments. Encourage the teams to use visual aids and activities to illustrate their geologic concepts.

6. Collect student-generated materials prior to presentations

Each team should turn in an activity sheet and a vocabulary list that will be photocopied for each student.

7. Presentations

These should occur in their numbered order for logical sequencing. Allow time for students to ask questions and complete their worksheets. Challenge the class to come up with at least three questions to pose to the presenting team.

8. Reinforce concepts

Summarize student presentations to provide foundational knowledge for upcoming field trip. The more students understand about plate tectonics, the more their visit to the Earthquake Trail or Mount Vision Overlook will be.

Extension Ideas

1. Divide vocabulary terms among students. Which ones could be better understood through illustrations or further detail? Develop a "Geologic Dictionary" that can be brought on field trip.
2. Investigate geologic research in the National Park System. If you navigate to **www.nps.gov** and select the following topics (Nature Net, Geology, Hot Topics in Geologic Resources) you will arrive at a chronological list of relevant issues and events. Have students pick one of interest and write a brief report summarizing information and pertinence to their lives.

Responsibilities for Team Presentations



YOUR CHALLENGE IS TO
PREPARE A PRESENTATION
DESIGN AN ACTIVITY SHEET
and PROVIDE VOCABULARY
FOR A GEOLOGIC TOPIC

1. Use your focus questions to begin research for your geologic topic.
2. As you work on the organization of your presentation, develop a one-page activity sheet that other students in the class will complete during your discussion. Make them think! If you make the questions too hard or too easy, you may lose their interest.
3. Prepare a vocabulary sheet for any words you will mention in your presentation that require an explanation.
4. Prior to your presentation, your teacher will need from you the following to provide copies to other students: activity sheet, answer key for activity sheet, vocabulary list.
5. When you prepare your presentation use visual aids, skits, or models that will help get your concepts across. Make learning your information fun and interesting!
6. Help the team following yours by providing a transition or bridge into their presentation.

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Name _____ Date _____

FOCUS QUESTIONS FOR TEAM 1

Topic: What Is the Structure of the Earth?

- How old is the earth?
- How many layers make up the earth, and what is their composition and thickness?
- Did the earth always have the same number of layers, or did it form in stages?
- What studies have geologists conducted to learn the structure of the earth?
- How does the structure of the earth contribute to earthquakes?

Presentation following yours will be "What Is Plate Tectonics?"

FOCUS QUESTIONS FOR TEAM 2

Topic: What Is Plate Tectonics?

- What is the definition for plate tectonics?
- What causes these plates to move?
- Are there ways to categorize how the plates meet and what directions they move?
- Is there a difference between plate movements whether they occur on land or in water?
- What plates immediately influence California and Point Reyes National Seashore?
- If you were looking at a map of the earth showing its plate tectonics, what relationship would that have to a map showing earthquake occurrences?

Presentation following yours will be "What Is an Earthquake?"

FOCUS QUESTIONS FOR TEAM 3

Topic: What Is an Earthquake?

- What is the definition of an earthquake?
- What are P and S waves, and what part of the earth's structure do they affect?
- How do scientists use these two types of waves to discover an epicenter?
- Why is it important to know the epicenter?
- What are some visual examples on the landscape of an earthquake having happened?
- What instrument is used to determine if an earthquake happened?

Presentation following yours will be "How Are Earthquakes Detected?"



Activity Sheet

Name _____ Date _____

FOCUS QUESTIONS FOR TEAM 4

Topic: How Are Earthquakes Detected?

- How does a seismograph work?
- If you had a seismograph reading that displayed a zigzag pattern, how would that information correlate to the two types of waves (P and S)?
- Is it important to have more than one seismograph in an active area?
- Once you know an earthquake occurred, what "scales" are used to measure it?

Presentation following yours will be "How Are Earthquakes Measured?"

FOCUS QUESTIONS FOR TEAM 5

Topic: How Are Earthquakes Measured?

- What is the Richter scale?
- What is the Mercalli Intensity scale?
- What are the similarities and differences between these two systems of comparison?
- What is the difference between magnitude and intensity?
- What fault moved on April 18, 1906, in San Francisco, and what was its measurement?

Presentation following yours will be "What Is a Fault?"

FOCUS QUESTIONS FOR TEAM 6

Topic: What Is a Fault?

- In geology what is the difference between a joint and a fault?
- List three types of faulting.
- What are the three major types of plate boundaries?
- In which part (or layer) of the earth does faulting occur?
- What is the relationship between plate tectonics and major faults
- What type of fault is the San Andreas Fault?

Presentation following yours will be "What Is the San Andreas Fault?"



Name _____ Date _____



FOCUS QUESTIONS FOR TEAM 7

Topic: What Is the San Andreas Fault?

- Where does the San Andreas Fault lie in the state of California?
- What other places in the National Park Service does this fault travel through?
- What other major cities in California does this fault travel through?
- What is the history of movement along this fault in recorded history?
- Is there evidence that this fault moved before recorded history?
- When could the next large earthquake occur along the San Andreas Fault?

Activity Sheet





How Can We Prepare for Our Visit to Point Reyes National Seashore?

Students will prepare for upcoming field visit by constructing and reviewing their personal field journals.

Time required: 1 hour

Location: classroom

Group size: all

Subjects: science, math, writing

Concept covered: preparation for geology field trip

Written by: Christie Denzel Anastasia and Lynne Dominy,
National Park Service

Last updated: 04/10/00

Pre-
Visit

Lesson Plan

Student Outcomes:

At the end of this activity, the students will be able to:

- Utilize field journals while visiting Point Reyes National Seashore

California Science Standards Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

- 6th grade 7b - select and use appropriate tools and technology to perform tests, collect and display data
 7h - identify natural changes in natural phenomena over time without manipulating the phenomena
- 7th grade 7a - select and use appropriate tools and technology to perform tests, collect and display data
- 8th grade 9b - evaluate the accuracy and reproducibility of data

National Science Standard Links (Grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A - Use appropriate tools and techniques to gather, analyze, and interpret data; understanding about scientific inquiry.
- Content Standard G - Science as a human endeavor; Nature of science: students formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models.

Creating
COASTAL
STEWARDSHIP
through Science





Materials

To be photocopied from this guide:

- Field Journal Sheets for each student (these sheets are located with the on-site lesson)

Vocabulary

generated by student inquiry

Procedures

1. Construct field journals

See the attached sheet for **Tips for Constructing Field Journals**. Hand out photocopies of the unit worksheets and have students assemble their field journals. Most groups will use **What Makes the Geology of Point Reyes National Seashore So Special?** field journal (page 53). Groups with more time and experience should consider using **What Does a Fault Zone Look Like?** field journal (page 93).

2. Review field trip logistics

Students will break into two groups. Both groups will begin at the Bear Valley Visitor Center to use restrooms and get drinking water. One group will remain at the Bear Valley Visitor Center to complete the activity in their journal labeled **Bear Valley Visitor Center Activity**. The other group will begin the Earthquake Trail. When the group on the Trail finishes, may go to the Bear Valley Visitor Center to complete their worksheets. Staggering the groups in this manner prevents large groups of students all trying to read one sign at the same time.

3. Important note

The **What Makes the Geology of Point Reyes National Seashore So Special?** field journal is based on signs installed in 1976. These signs will be updated and replaced by September 2003. If you are planning a field trip after that date, contact the Education Specialist at (415-464-5219) for an updated field journal based on the new signs.

Tips for Creating Field Journals



Journal Tips

Materials

- ☐ Field Journal Sheets for each student, teacher, and chaperone
- ☐ One package blank paper and one package lined paper
- ☐ Colored paper, cardstock, or cardboard for journal covers
- ☐ Markers or colored pencils for decorating covers
- ☐ three-hole punch
- ☐ String, binding tape or twigs and rubber bands for binding
- ☐ Pencil on a string for each student
- ☐ Two plastic pencil sharpeners and extra pencils for field trip
- ☐ One box of large ziplock bags to rainproof journals

Procedures

1. Photocopy all of the unit handouts and provide each student with double-sided copies. Use recycled paper if it is available.
2. Provide five additional sheets of blank paper and five sheets lined paper to each student.
3. Have students create front and back covers for their journals using blank sheets of paper.
4. Have students bind their journals using binding tape, hole punches and string, cardboard, or a twig bound by rubber bands threaded through holes.
5. Once journals are bound, have students decorate the covers.
6. Have each student attach a sharpened pencil on a long string through a hole in the journal binding.
7. Have each student use a magic marker to write their name on the front cover of their journal.
8. Students will need a sturdy writing surface behind their field journals. Incorporate cardboard as the last page or have clipboards available for each student.

Extension ideas

1. Create a journal that is used throughout the year.
2. Share student journals with parents at open houses.
3. Students may choose to use their journals to create a class newsletter, resource newspaper, or a class website.



Safety and Stewardship Challenge



Students will learn how to protect themselves and the resources in a National Park. This will be accomplished by simulating a group "game show" and completing the first page of their field journals.

Time required: 1 hour

Location: classroom

Suggested group size: any

Subject: science

Concepts covered: low-impact use of natural areas, behaviors in a National Park, safety

Written by: Christie Denzel Anastasia and Lynne Dominy,
National Park Service

Last updated: 06/20/00

Pre-Visit Lesson Plan

Student Outcomes

At the end of this activity, the students will be able to:

- List three safety precautions for upcoming field trip
- List three proper behaviors for geology field visits
- Understand the role of the National Park System and stewardship

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard F - Personal health: Injury prevention; Populations, resources, and environment.

Materials

To be provided by the teacher:

- Desk bell (or other device to indicate which team has the first answer)

To be photocopied from this guide:

- Safety and Stewardship Challenge Questions Teacher Information Sheet (one set)

Vocabulary

stewardship





Procedures

1. Divide class into teams

Option A: If class can work as large teams, divide the class into two teams. Each team will need a spokesperson and team name. Answers will come from the entire group. Spokesperson can change throughout the game.

Option B: If class may get too loud, students can still be divided into teams, but answers will come from individuals on each team. One person from each team will be assigned a number. Team A and Team B will each have a #1, #2, etc. Randomly choose a number from hat. The student with that specific number from each team will be responsible for answering the question. Random choice of numbers will help students pay attention if they aren't quite sure when their turn will occur.

2. Draw challenge grid and scorecard on blackboard

There are four categories with questions of varying value. As a finale, there is a final jeopardy question. Draw this grid on the chalkboard:

Safety and Stewardship Challenge			
Category #1 Take Care of Yourself	Category #2 Minimize Your Impact	Category #3 Geology Etiquette	Category #4 The National Park Service
1 point	1 point	1 point	1 point
2 points	2 points	2 points	2 points
3 points		3 points	
4 points	3 points	4 points	3 points
		5 points	
Final Challenge			

3. Choose game show hosts

Option A: Teacher is responsible for asking all of the questions.

Option B: Four students will become "Challenge Hosts". Each student receives questions for a specific category and will ask appropriate questions according to point value.



4. Rules of the game

- A coin flip will determine which team goes first.
- The game will end when a predetermined time runs out or when all questions have been answered.
- Team will decide which category and value of question will be asked.
- Spokespersons or individuals will poise themselves on either side of the desk bell with one hand behind their backs.
- After the question is asked, the first team to have an answer will ring the bell and respond. If they are correct, the team receives the full point value.
- If they are incorrect, the other team gets a chance. If they also get it wrong, the first team can try again for one less point.
- When brainstorming answers, students should whisper, or the other team may hear their answer.
- When all of the categories are complete (or 5 minutes before a predetermined "game-over" time), class will go into "Final Challenge". Each team decides on amount of wager, listens to question, and writes down answer on a sheet of paper. Each team reveals answer.
- At the end of the game, the team with the most points "wins", but everyone wins if your visit to Point Reyes National Seashore is safe for themselves and the resources.

5. Complete first page of field journal.

Using the information gained in this "game show", have students list at least three items under each category on the first page of their journal (**Things to Remember While on Geology Field Trip**).

Safety and Stewardship Challenge Questions



Teacher Information

CATEGORY #1: Take Care of Yourself

1 point

Bring a water bottle and drink plenty of water because...

- A you will not be able to speak well with a dry throat.
- B not drinking enough water can give you a headache and cause you to make bad decisions.**
- C a heavy water bottle will slow you down as you are walking.
- D all of the above

2 points

If the sun feels warm, you should...

- A try to get a tan.
- B use sunglasses, sunscreen, and/or a hat.**
- C take off your shoes and walk barefoot.
- D all of the above

3 points

Cliff edges in Point Reyes National Seashore are...

- A made of granite and safe as long as you have one foot flat on the ground at all times.
- B sandy, loose, and slippery; be careful at all times.**
- C safe if you have good balance.
- D the best places for a good view.

4 points

The best way to dress for a field trip:

- A comfortable, closed-toe shoes.
- B a T-shirt and a heavy, waterproof jacket.
- C "like an onion," many thin layers with a waterproof one on the outside.**
- D A and C



Safety and Stewardship Challenge Questions

CATEGORY #2: Minimize Your Impact

1 point

When visiting Point Reyes National Seashore, you should stay on trails because...

- A you are more likely to pick up a tick in grassy areas.
- B when you travel off-trail you can damage plants.
- C you are speeding up erosion.
- D **all of the above**

2 points

It's okay to take home just one rock from Point Reyes National Seashore.

- A Sure, it's just one, but let your teacher know.
- B No; every rock is home to many bugs and plants.
- C **No, with 2.5 million visitors, the Seashore would be rock-less if every visitor collected just one.**
- D B and C

3 points

Trash is....

- A okay to hide behind bushes in a National Park because it will eventually break down.
- B not a good source of food for hungry animals.
- C **not a part of the Point Reyes National Seashore ecosystem and should be properly disposed of whether it's your trash, or trash that someone else accidentally dropped.**
- D only the responsibility of the maintenance staff, wherever it is.

Safety and Stewardship Challenge Questions



Teacher Information

CATEGORY #3: Geology Etiquette

1 point (Note: there are two answers for each question in Category #3)

If you found a whale fossil at one of the beaches in Point Reyes National Seashore, you could legally:

- A take it home to decorate your bedroom.
- B sell it to the highest bidder.
- C **notify a Park Ranger.**
- D leave it where you found it because every fossil and its location are irreplaceable clues to our ecological history.

2 points

What can a rock "tell you"?

- A **Depending on the rock type, it can tell you about the conditions where it was formed, where it has moved, and what processes have occurred.**
- B **Depending on the rock type, it may tell you about plants that were around because of the pollen fossils located inside.**
- C How much longer it has until it becomes sand or part of another rock.
- D If and when you are destined to win the lottery.

3 points

The best way to observe a rock in a National Park is to...

- A break it apart to see what's inside.
- B collect several samples to bring back home for your collection
- C **take a close-up picture.**
- D **carry a geologic map of the Park to determine which rock unit corresponds to your rock.**

4 points

All of the rock ledges in Point Reyes National Seashore are...

- A safe.
- B **subject to crumble while you are standing on them.**
- C **slippery when wet.**
- D not very high up from softer ground if you fall.

5 points

Some rocks in Point Reyes National Seashore could be...

- A insignificant in any way.
- B **tools the Coast Miwok Indians used when they lived within the Park's boundaries.**
- C fake to make it look prettier.
- D **tools from settlers, whalers, and gold hunters.**



Safety and Stewardship Challenge Questions

CATEGORY #4: The National Park Service

1 point

Which of the following is not in the National Park Service?

- A Grand Canyon National Park, AZ
- B Keweenaw National Historical Park, MI
- C **Monterey Bay Aquarium, CA**
- D Golden Gate National Recreation Area, CA
- E Yosemite National Park, CA

2 points

I should treat Point Reyes National Seashore with respect because...

- A it belongs to everyone in the entire United States.
- B it preserves a part of the ecosystem you live in and depend on.
- C it's one of the few places natural processes can happen with little intervention from human society.
- D **all of the above**

3 points

Which of the following is the mission of the National Park Service?

- A Preserve natural and cultural resources.
- B Provide for the enjoyment, education, and inspiration of this generation.
- C To care for special places saved by the American people so that all may experience our heritage.
- D Cooperate with other resource-conservation and outdoor-recreation organizations in our country and the world.
- E **all of the above**